

# **Runoff Quantity: Progressing beyond Control of Peak Flow Rates**

## **The Peak Flow Standard**

The current standard for regulating runoff quantity from new developments is the “peak flow” standard in the Stormwater Management rules (Chapter 500). This standard requires that peak runoff rates from a developed site do not exceed those from the pre-developed site for three defined storms – the 2-year, 10-year, and 25-year events. The department took this standard directly from the Site Location of Development Act’s regulations for stormwater runoff. These regulations had been in place since the 1980s and had provided a quantifiable check for the “no unreasonable impact to infiltration/runoff relationships” demanded of new developments. Generally, this standard was an adoption of public works engineering philosophy into the field of watershed management. Since this standard was familiar to the department, developers, and engineering consultants, the department adopted the standard into the *Stormwater Management Law* in 1997 without recognizing the standard’s limitations.

## **Why the peak flow standard fails to protect streams**

The peak flow standard, by itself, is inadequate for protecting streams in developing watersheds. Essentially, brooks, streams, and wetlands in developing watersheds become just what the peak flow standard demands from them: streams degrade to become mere conveyances of storm flows and wetlands become stormwater detention basins. All other functions become impaired or lost as development progresses. This is due to two severe weaknesses of the peak flow standard.

First, the peak-flow standard focuses on only one aspect of runoff hydrology: peak runoff rates. Controlling peak runoff rates is sufficient if one’s concern is designing (or protecting) culverts, road ditches, and storm sewers. These structures usually have one function – convey runoff away from developed areas without flooding other developed areas. Controlling only runoff rates is insufficient, however, if one’s concern is protecting natural resources. Brooks and streams are significantly affected by changes to the flows within them. Control of runoff duration, runoff frequency, and runoff volume are needed if all stream functions and values are to be preserved.

Second, the storms chosen in the regulations – the 2, 10, and 25-year storms – represent only extreme events within the annual precipitation range for a watershed. These extreme storms are unusual and represent only a small fraction of the annual precipitation falling on a site and, consequently, the annual runoff flowing off developed areas. The peak flow standard offers little to no control of runoff from the smaller, more frequent storms that produce most of the development runoff reaching brooks and streams. It is runoff from these small storms that largely determine how a stream will function and transform in response to changes in land use.

## **The need for new standards for stream protection**

New standards for runoff quantity are needed to improve the peak flow standard used for so long. Ideally, a new runoff quantity standard would match a site’s post-development hydrology to its pre-development hydrology. This is impractical for most sites if the cost of site investigation and design is to be kept reasonable, permitting time is not to increase substantially, and management of stormwater systems is to remain largely passive. As an alternative, the Department is proposing standards that curtail the damage from stream altering flows while maintaining control of peak flow rates during severe storms.

The stream protection standard would prevent damage to streams by using extended detention as the minimum runoff control necessary on most development sites. Extended detention manages flow from the smaller, more frequent storms that the peak-flow standard neglects. This is done crudely by detaining

runoff from small storms in detention basins for extended periods so to get much lower runoff discharge rates over much longer lengths of time. Extended detention releases runoff at such low rates that the duration and frequency of stream-altering flows does not increase or exacerbate with growing development in the watershed.

The stream flooding standard would retain peak flow control on larger developments (> 3 acres impervious area). When combined with the extended detention necessary under the stream protection standard, the stream flooding standard would reasonably guarantee that peak flows would still be controlled for severe storms up to the 25-year event. On smaller projects not needing to meet the stream flooding standard (< 3 acres of impervious area), peak flow rates would not usually be controlled for any storm larger than the 2-year event.

Overall, detention basins built to control runoff from smaller developments needing to meet just the stream protection standard would be slightly smaller than those currently built to meet the peak flow standard. Detention basins built to control runoff from large developments having to meet both the stream protection and stream flooding standards would be slightly larger in size than currently needed.

### **Concerns still to be addressed**

The department has yet to resolve some issues regarding implementation of the stream protection and stream flooding standards. These are described below.

**Can buffers still be used to meet the runoff quantity standards?** Buffers could be used to meet the new stream protection standard; however, new buffer requirements will be needed. The new requirements would need to acknowledge that buffers are limited in their capacity to absorb excess runoff volume from developed areas. Also, buffers vary in their ability to perform this function. Thus, the new buffer requirements for stormwater quantity control are likely to be more complex than those currently stipulated under the buffer variance in the Chapter 500 regulations.

**Should there be a “de minimus” limit on flow rates needing control?** Some states allow developments discharging runoff below a certain peak rate (such as 2 cfs for a 1-year storm) to forgo any control of runoff quantity. Apparently, such small flows are viewed as benign to stream systems. The department is considering a similar allowance for small flows from developments. To do so, it must determine how to manage the problem of cumulative impact. A horde of small developments meeting the “de minimus” allowance could still have the same impact to a stream as one large development not meeting the allowance.

**Is it desirable to control peak flow rates from small developments only up to the 2-year storm?** The duration of peak flow rates from smaller developments is so brief that it does not seem beneficial to control peak rates (as done currently) if small developments are already providing extended detention. This may not be true in all watersheds, particularly first order streams. Again, the issue of cumulative impacts needs to be considered.

**Should there be limits on the minimum outlet sizes for extended detention basins?** Extended detention of 12 and 24 hours will require the use of small orifices to restrict flows. There is a point where orifice size becomes so small that it's likely to clog repeatedly from debris or icing. The department is considering limiting the minimum orifice size to three inches to avoid these maintenance problems. Even smaller limits have been used by other states.